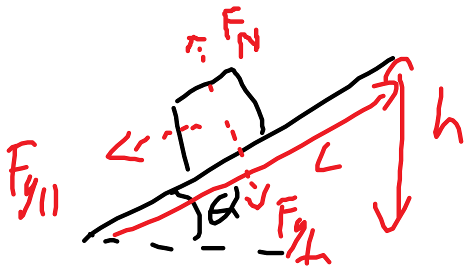
Slope lab:

Purpose: Determine relationship between the force required to pull a block up/down a slope and the angle.

Hypothesis:

component of gravity down a slope = $F_{g\parallel} = F_g \sin\theta$



$\sin\theta = \frac{h}{L}$

$F_{g\perp} = F_g \cos\theta$

$F_f = \mu F_N = \mu F_g \cos\theta$

μ is the coefficient of friction - constant

applied force, $F_a = \mu F_g \cos\theta +/- F_g \sin\theta$

depending if you are going up or down the slope

procedure: zero the force scale at each angle,

1. lift the block with the scale to record Fg
2. pull the block at a constant speed on the level board, calculate coefficient of friction, $\mu = Fa/Fg$
3. put one block under the ramp, measure h and L and calculate the angle $\theta = \sin^{-1}(h/L)$ pull the block up/down the slope record Fa.
4. repeat for more blocks
5. find the maximum angle the block will not slide by itself - record h.

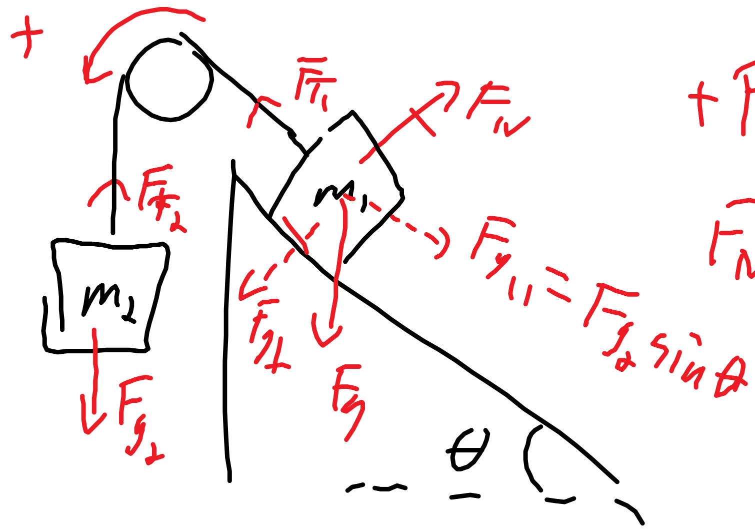
Observations

Fg_________ L_______

F	h	θ =	up or	$F_g \sin\theta$	μ Show your work

a		$\sin^{-1}(h/L)$	down		
	0 level				$=Fa/Fg$
O	max height		up down up down up down		$=(Fa+/-F_g\sin\theta)/F_g\cos\theta$

p96
q49



$+F_{T_1} = -F_{T_2}$

$F_N = F_{g_\perp}$

frictionless

total

$F_{net} = F_{g_2} - F_{g_1}\sin\theta = (m)a$

↑ $\mu F_{g_1}\cos\theta$

$\frac{(m_2 g - m_1 g \sin\theta)}{(m_1 + m_2)} = a$ ← no frictio

← depends of direction of v

← depends on direction of v

$$\frac{(m_2 g - m_1 g\sin\theta \ominus \mu m_1 g\cos\theta)}{(m_1 + m_2)} = a$$

↑ with friction

if $m_1 g \sin\theta > m_2 g$

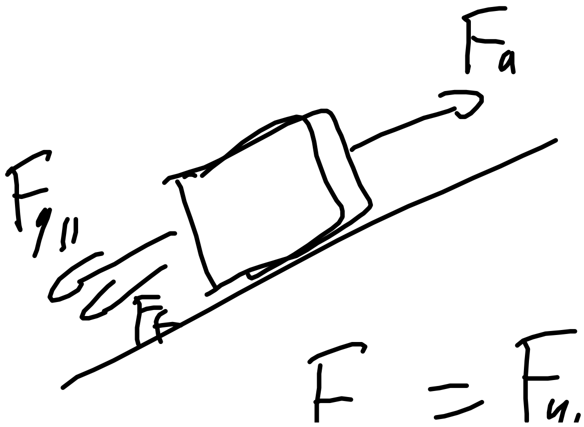
then it will slide down the slope and friction will act up the slope.

$$\mu m_1 \cancel{g} \cos\theta \geq m_2 \cancel{g} - m_1 \cancel{g} \sin\theta$$

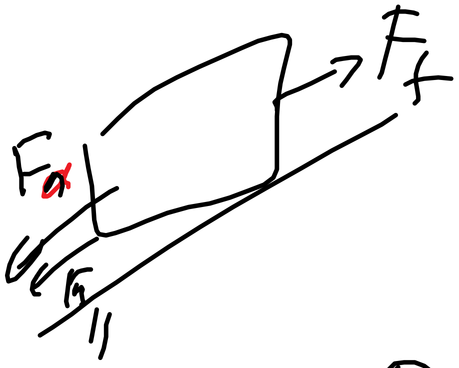
$$\mu (2\cancel{kg})(\cos 30) \geq (2kg) - 2kg \sin 30$$

$$\mu \geq \frac{1 - \sin 30}{\cos 30} \geq$$

$$\boxed{\mu \geq 0.577}$$



$$F = F_{\parallel} + F_f$$

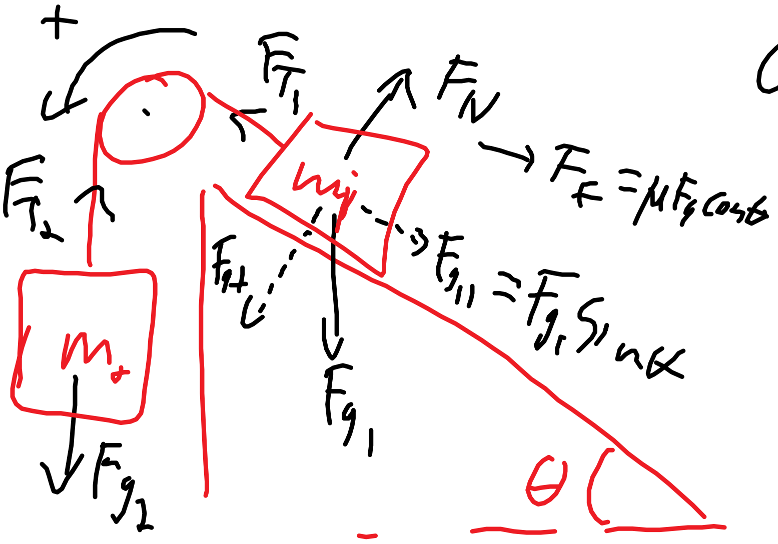


$$F_a = F_{g\parallel} + F_f$$

$$F_a - F_{g\parallel} = \mu F_g \cos\theta$$

$$F_a + F_{g\parallel} = F_f \qquad \mu > \frac{F_a - F_g \sin\theta}{F_g \cos\theta}$$

Q49 p96



$a = ?$

m_1, m_2, g, θ, μ

F_T cancel, $F_{g\perp}$ cancels by F_N

total ↓

$$F_{net} = \Sigma F = F_{g_2} - F_{g_1} \sin\theta - \mu F_{g_1} \cos\theta = ma$$

$$m_2 g - m_1 g \sin\theta - \mu m_1 g \cos\theta = (m_1 + m_2) a$$

$$a = \frac{m_2 g - m_1 g \sin\theta - \mu m_1 g \cos\theta}{}$$

← if m_1 sliding up

$$a = \frac{\ldots}{m_1 + m_2}$$

$m_2 g \geq m_1 g \sin\theta$ for m_2 to slide down

$$a = 0 = m_2 g - m_1 g \sin\theta - \mu m_1 g \cos\theta$$

$$\mu = \frac{m_2 g - m_1 g \sin\theta}{m_1 g \cos\theta}$$

$$= \frac{2kg - 2kg \sin 30}{2kg \cos 30} = \boxed{0.577}$$

$m_2 g - m_1 g \sin\theta - \mu m_1 g \cos\theta > 0$

then m_2 goes down m_1 slides up

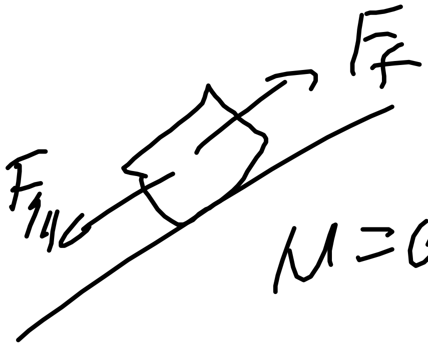
$m_2 g - m_1 g \sin\theta < \mu m_1 g \cos\theta$

doesn't move

$m_1 g \sin\theta > m_2 g + \mu m_1 g \cos\theta$

then m_1 slides down

m_2 goes up



$\mu = 0.8$

$F_{g\parallel} = F_f$

$\cancel{F_g} \sin\theta = \mu \cancel{F_g} \cos\theta$

$\mu = \frac{\sin\theta}{\cos\theta} = \tan\theta$

$\theta = \tan^{-1} \mu$